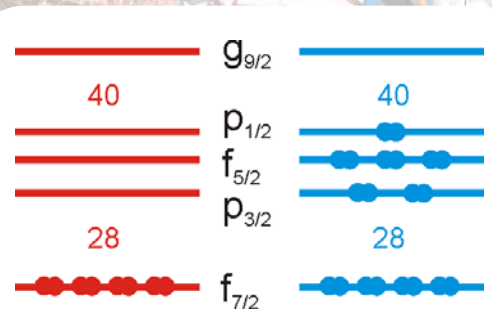
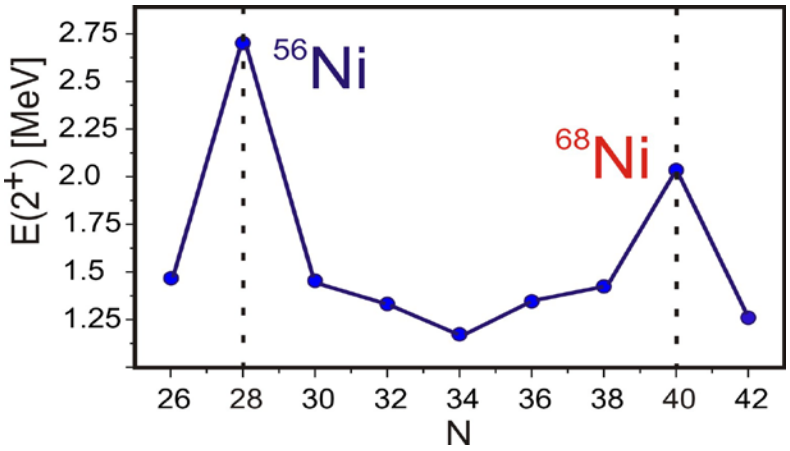
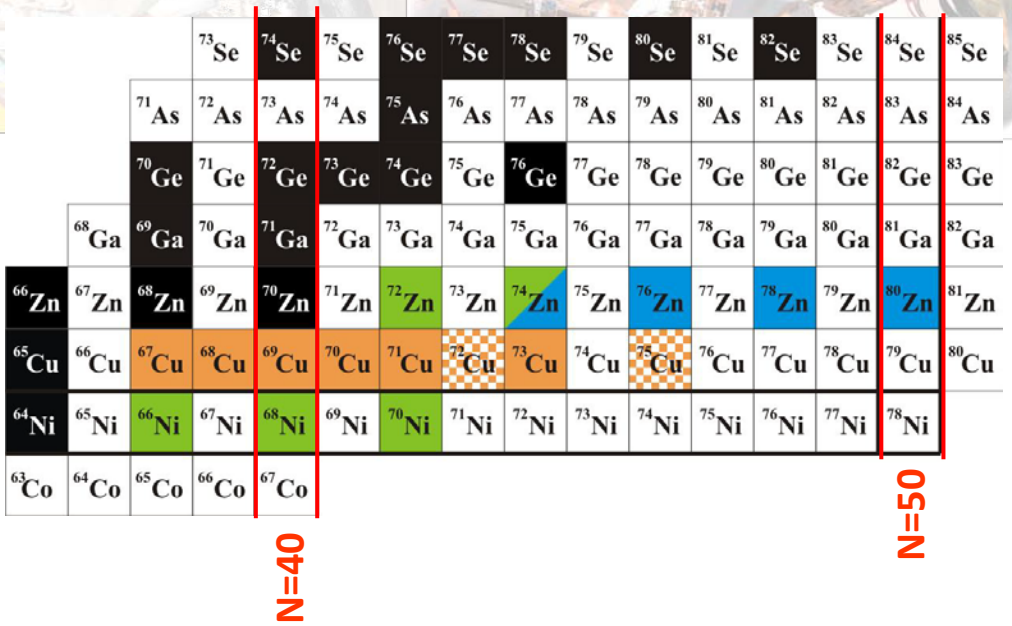
Coulomb Excitation of Isomeric states of ^{70}Cu

Elisa Rapisarda, IKS K.U. Leuven

N=40 and Coulex of the Cu isotopes







- n-rich Cu isotopes provide an excellent means for testing the proton-neutron residual interaction in this mass -region;

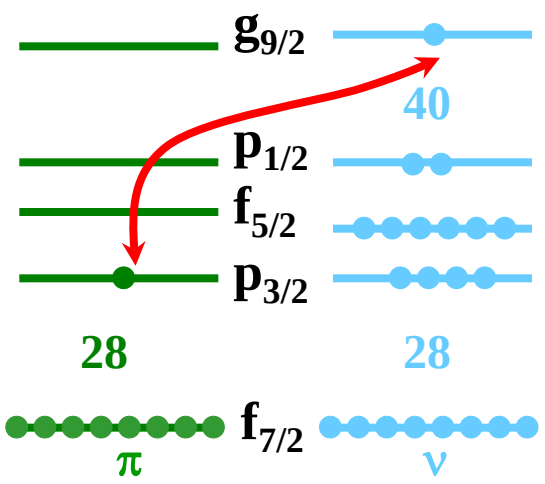
- ✓ **high $E(2^+)$ in ^{68}Ni** (R. Broda *et al.*, PRL 74 (95) 868)
  - ✓ **proposed new magic number N=40**

- ❑ 2005: Coulomb excitation of odd-odd ^{68,70}Cu;
- ❑ 2006: Coulomb excitation of odd-mass ^{67,69,71,73}Cu.

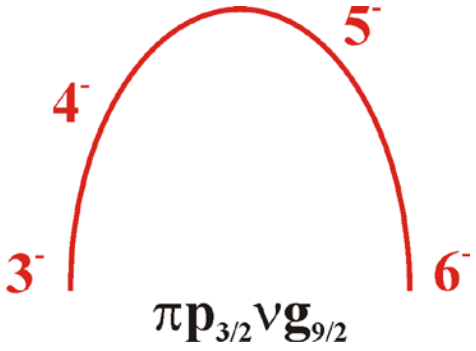
The odd – odd ^{70}Cu

- the low-energy level schemes dominated by multiplets originating from the coupling of the odd proton with the odd neutron $\pi p_{3/2} \oplus \nu g_{9/2}$ = $3^-, 4^-, 5^-, 6^-$;

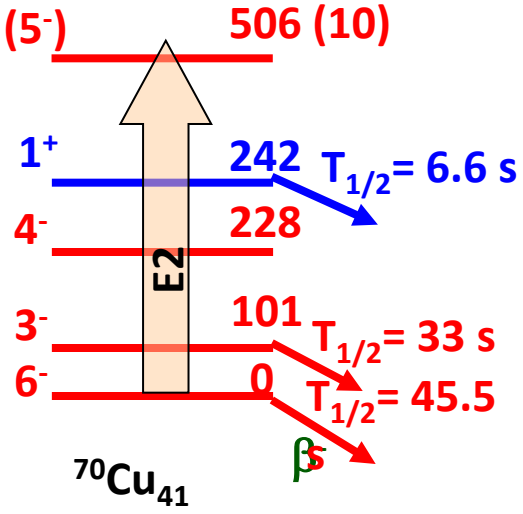
- B(E2) values within the states of the $\pi p_{3/2} \oplus \nu g_{9/2}$ multiplet offers important information about the *p-n* residual interaction across N=40.



$^{70}Cu_{41}$



V. Paar Nucl.Phys.A331(1979)16



$^{70}Cu_{41}$

^{70}Cu: J. Van Roosbroeck et al., PRL92(2004)112501, J. Van Roosbroeck et al., PRC69(2004)034313.

^{70}Cu: J. D. Sherman et al., Phys.Lett. B67(1977)275

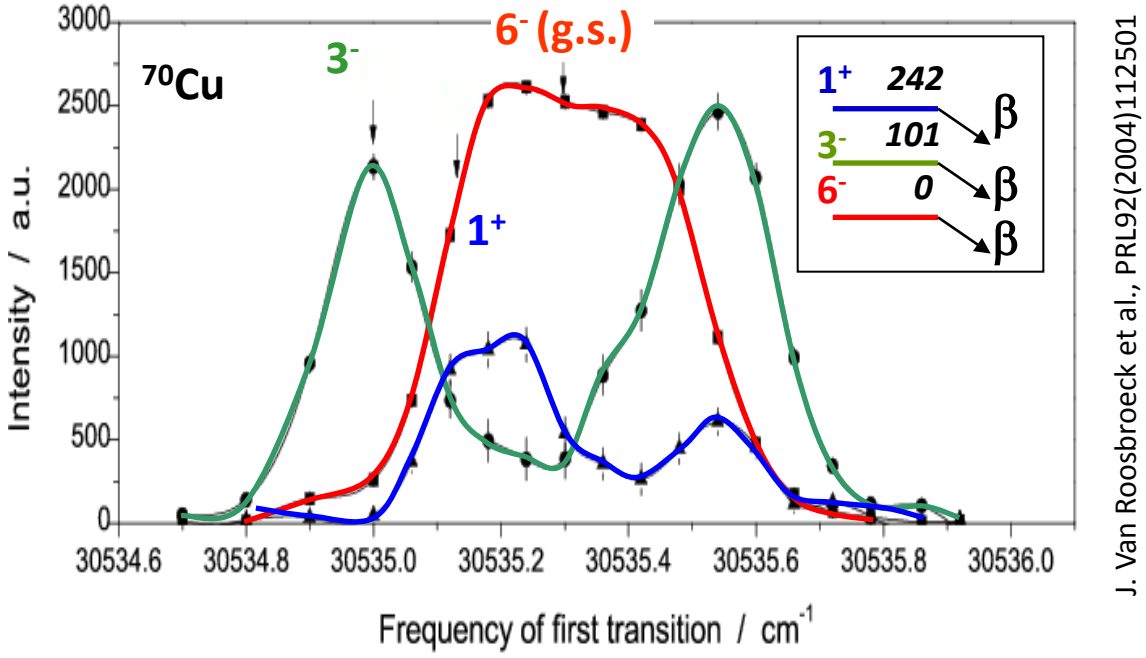
^{68,70}Cu: I. Stefanescu et al., Phys.Rev. Lett 98(2007)122701

Isomeric Beams from REX-ISOLDE

- technique based on in-source laser spectroscopy

(Ü. Köster et al., NIM B, 160, 528(2000); L. Weissman et al., PRC65, 024315(2000)).

- set the laser frequency to select and maximize the production of the isomer of interest.



J. Van Roosbroeck et al., PRL92(2004)112501

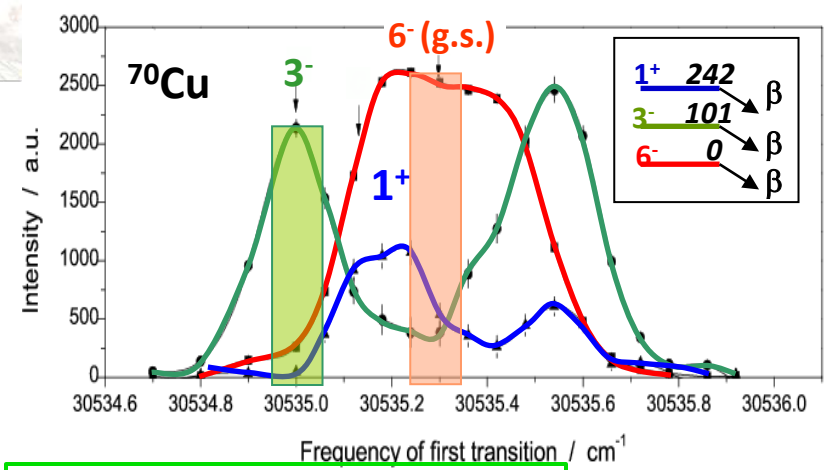
+ postacceleration by REX-ISOLDE

Experimental details

^{70}Cu on ^{120}Sn

Beam energy: 2,83 MeV/u

Beam Intensity: 5 X 10^5 pps



^{70}Cu/^{70}Ga = 80%/20%

^{70}Cu:

6^- → 86%
3^- → 7%
1^+ →7%

Isomeric Composition determined from characteristic beta decay lines

^{70}Cu/^{70}Ga = 50%/50%

^{70}Cu:

6^- → 72%
3^- → 25%
1^+ →less than 3%

Inclusive excitation cross-section

Inclusive excitation cross-section

disentangle

σ (6^- → XXX) and σ (3^- → XXX)

^{68,70}Cu: I. Stefanescu et al., Phys.Rev. Lett 98(2007)122701

^{70}Ga contamination

The separator is not able to separate ^{70}Cu from ^{70}Ga

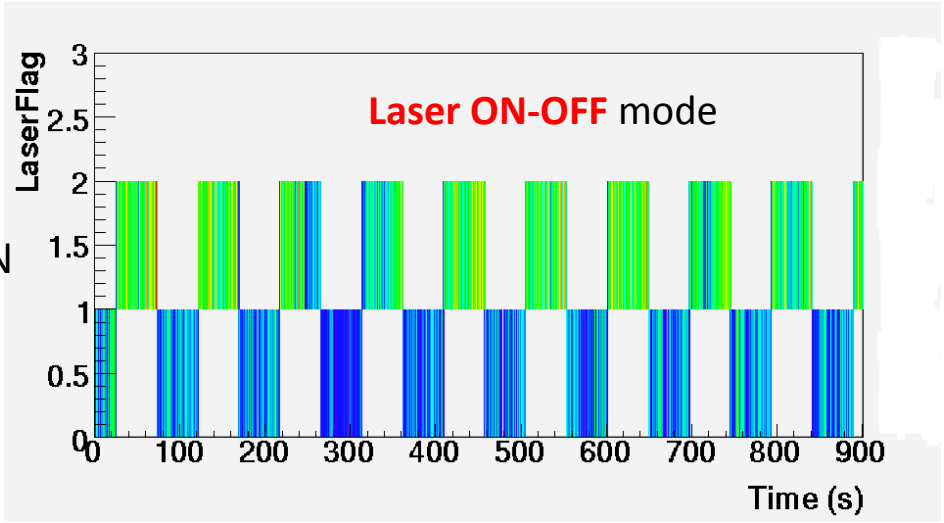
^{70}Ga and **^{70}Cu** impinges both on target

Laser ON – Laser OFF to disentangle Cu interaction from Ga interactions

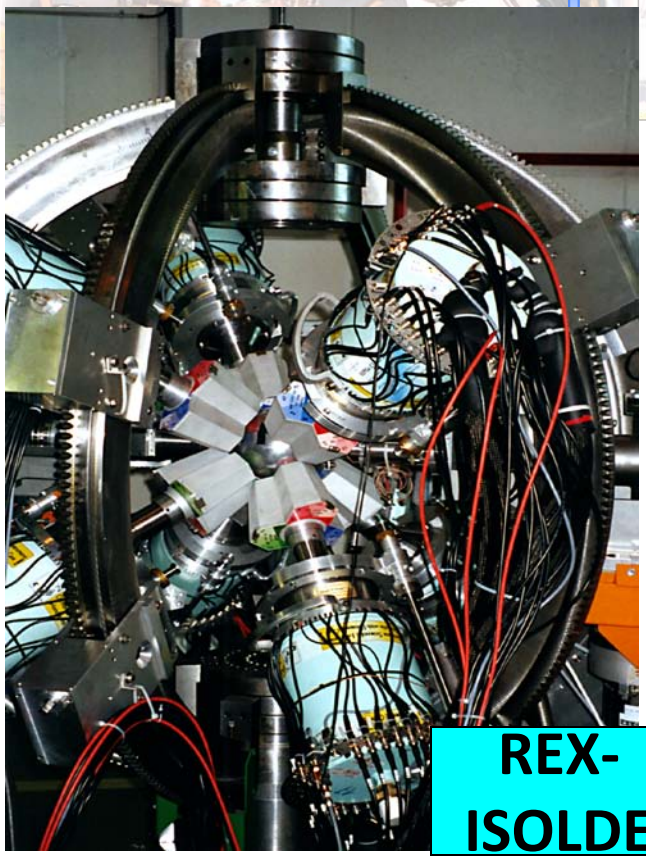
Laser ON ^{70}Cu + ^{70}Ga

Laser OFF ^{70}Ga

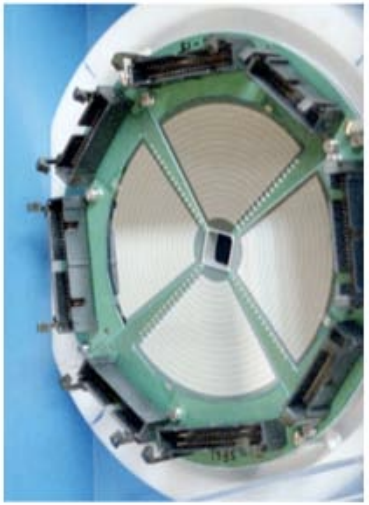
Ga contribution can be precisely substracted provided a precise normalization of Laser ON laser OFF run

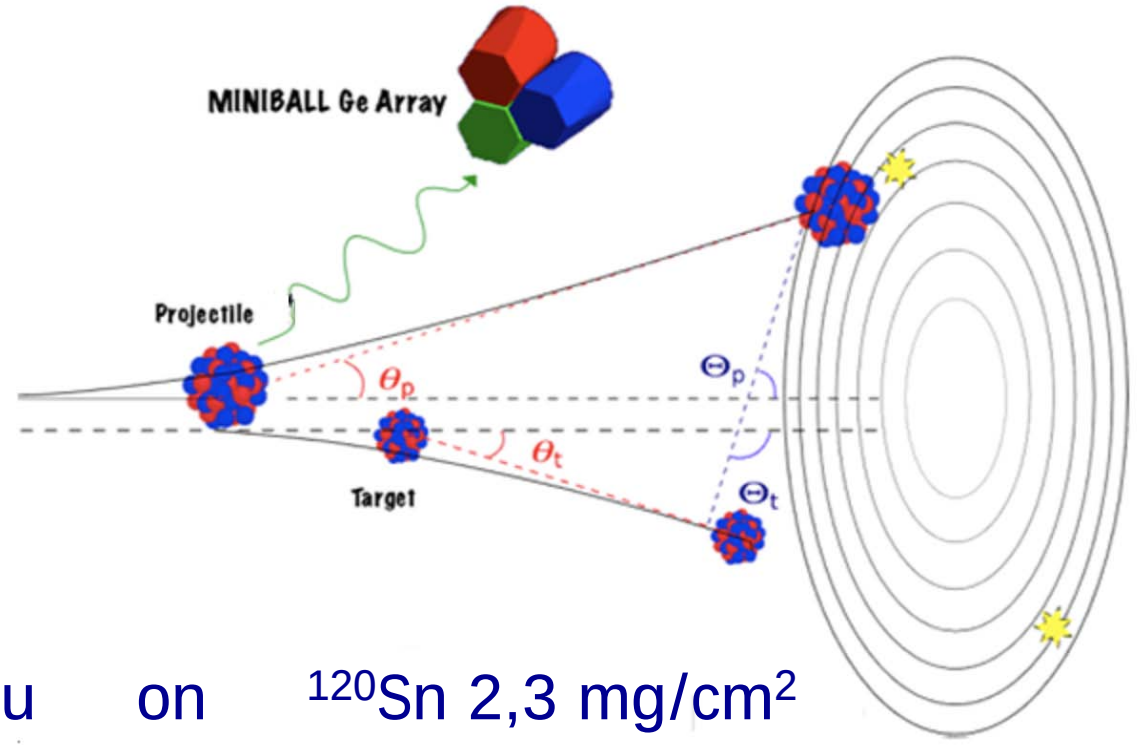


Experimental Setup



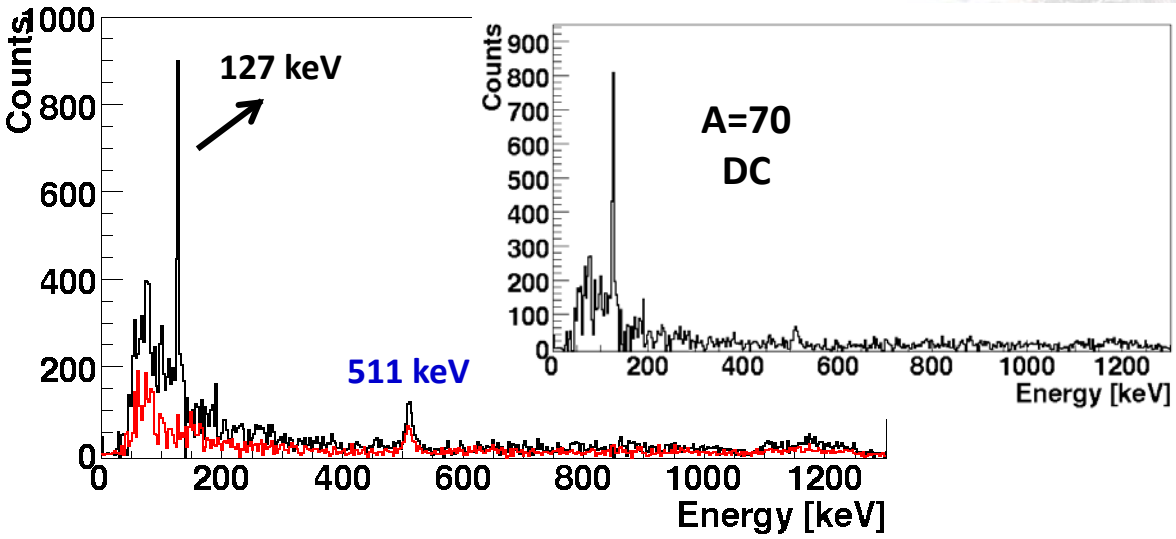
REX-ISOLDE

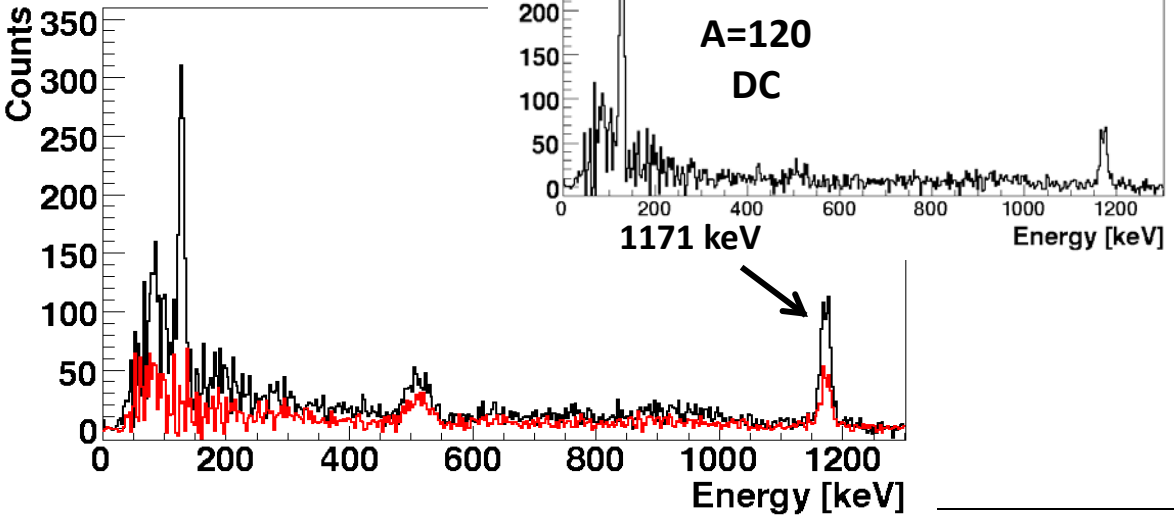


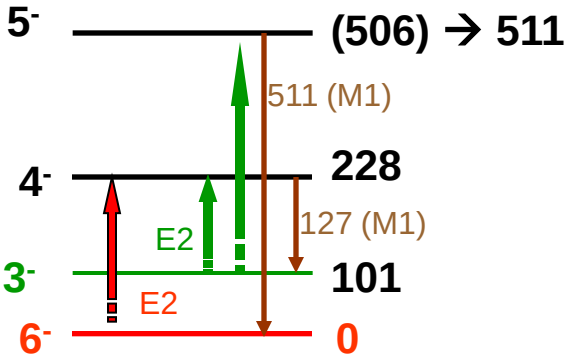


^{70}Cu 2,9 MeV/u on ^{120}Sn 2,3 mg/cm^2

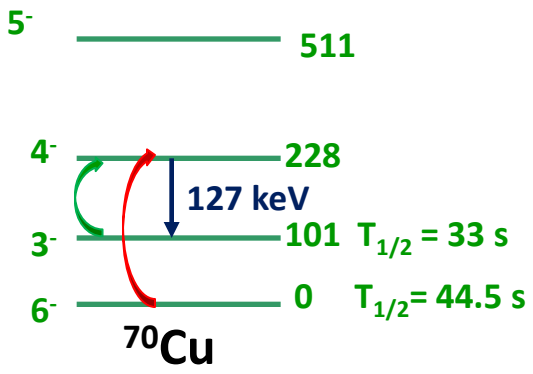
Coulomb Excitation of ^{70,gs}Cu and ^{70,m1}Cu

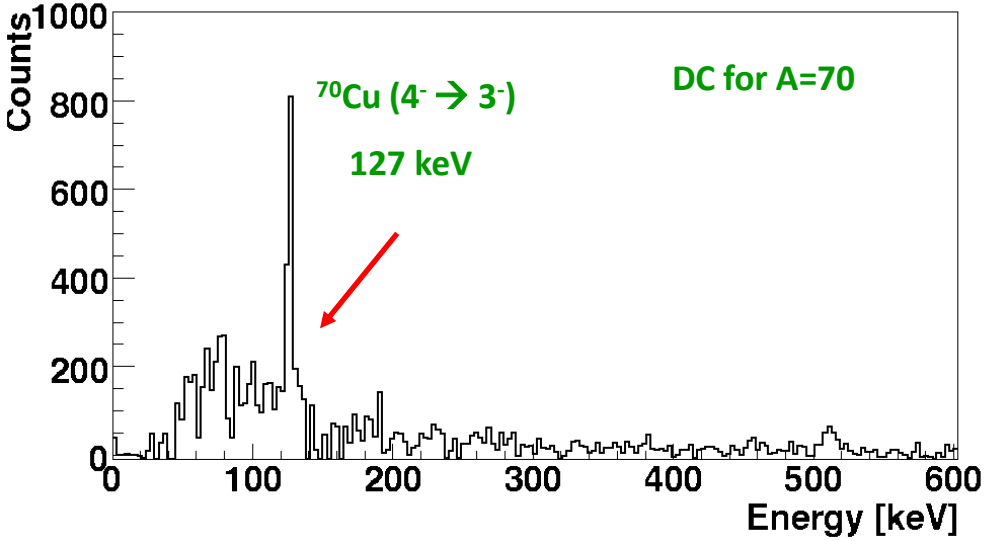






Cross Section: 127 KeV



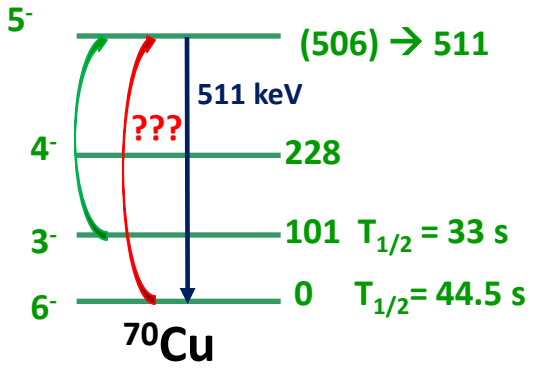


Measurement of the **(4⁻ → 3⁻)** cross section in both experiments
Isomeric Composition of the ^{70}Cu beam is known
Disentangle the σ **(6⁻ → 4⁻)** and σ **(3⁻ → 4⁻)**

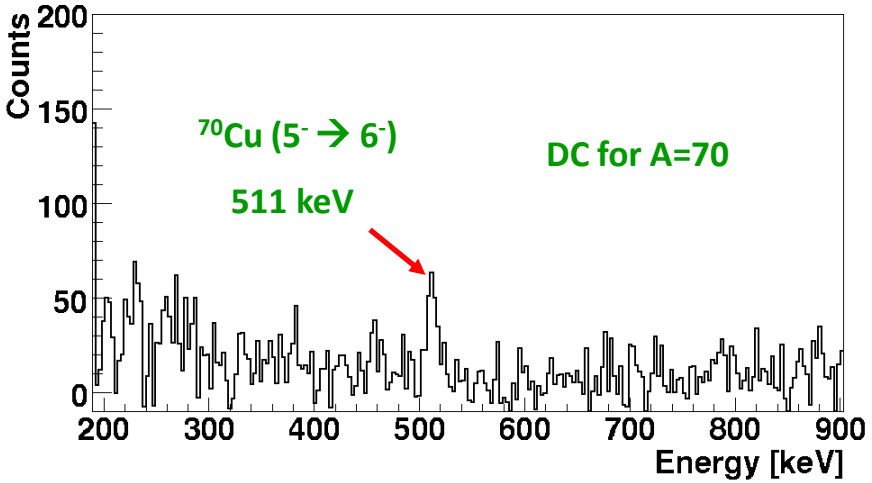
- CLX code
- Matrix element = 0.23(3) eb
- B(E2, 3⁻ → 4⁻) = 73(10) e^2 fm^4

- CLX code
- Matrix element 0.30(4) eb
- B(E2, 6⁻ → 4⁻) = 69(9) e^2 fm^4

Cross-Section 511 KeV



Challenge to measure



Assuming only **(3⁻ → 5⁻) excitations**

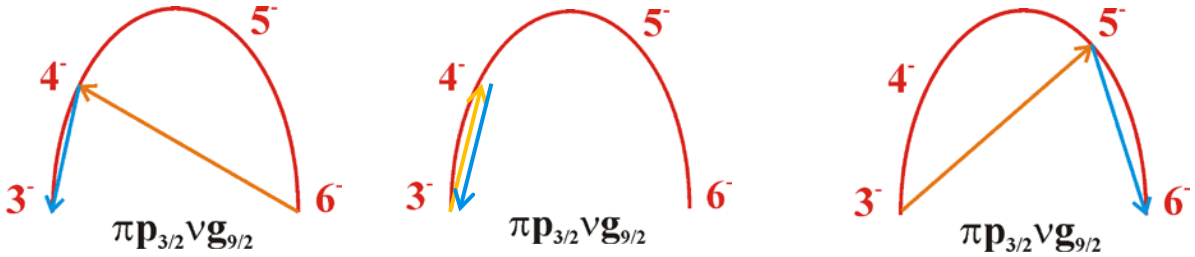
- CLX code
- Matrix element 0.30(3) eb
- B(E2, $3^- \rightarrow 5^-$) = 128(17) $e^2\,fm^4$

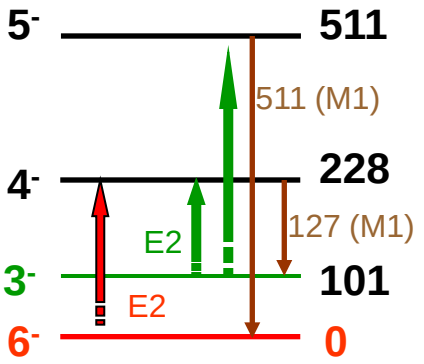
Upper Limit

Summary and more …

• the observation of the 511 KeV decaying transition fixes the energy, spin and parity assignment of the 5^- level;

• E2 transitions between the multiplet of states have been investigated





• For these transitions the following B(E2) values have been measured:

- B(E2, $6^- \rightarrow 4^-$) = 69(9) e^2 fm^4
- B(E2, $3^- \rightarrow 4^-$) = 73(10) e^2 fm^4
- B(E2, $3^- \rightarrow 5^-$) = 128(17) e^2 fm^4

… next steps

• Comparison with Shell Model Calculation using different effective nucleon-nucleon interactions

• Comparison with the existing systematic of other n-rich Cu isotopes to come to a coherent picture in this mass region

Collaboration

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- ✓ **University of Liverpool, UK -** P. Butler
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- ✓ **CERN, Geneva, Switzerland -** J. Cederkäll, A. Ekström, L.M. Fraile, P. Delahaye, V. Fedoseev, U. Köster, B. A. Marsh, T. Sieber, D. Voulot, F. Wenander

and the ISOLDE and Miniball collaborations

Acknowledgement: Marie Curie Intra-European Fellowship of the EC's FP7